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Vortex Interactions on Plunging Airfoil and Wings AZAR ESLAM PANAH, JAMES BUCHHOLZ, University of Iowa — The development of robust qualitative and quantitative models for the vorticity fields generated by oscillating foils and wings can provide a framework in which to understand flow interactions within groups of unsteady lifting bodies (e.g. shoals of birds, fish, MAV's), and inform low-order aerodynamic models. In the present experimental study, the flow fields generated by a plunging flat-plate airfoil and finite-aspect-ratio wing are characterized in terms of vortex topology, and circulation at Re=10,000. Strouhal numbers (St=fA/U) between 0.1 and 0.6 are investigated for plunge amplitudes of $h_o/c = 0.2$, 0.3, and 0.4, resulting in reduced frequencies ($k=\pi\, fc/U$) between 0.39 and 4.71. For the nominally two-dimensional airfoil, the number of discrete vortex structures shed from the trailing edge, and the trajectory of the leading edge vortex (LEV) and its interaction with trailing edge vortex (TEV) are found to be primarily governed by k; however, for St>0.4, the role of St on these phenomena increases. Likewise, circulation of the TEV exhibits a dependence on k; however, the circulation of the LEV depends primarily on St. The growth and ultimate strength of the LEV depends strongly on its interaction with the body; in particular, with a region of opposite-sign vorticity generated on the surface of the body due to the influence of the LEV. In the finite-aspect-ratio case, spanwise flow is also a significant factor. The roles of these phenomena on vortex evolution and strength will be discussed in detail.

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